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The Weight Reduction Effect of Yeast Hydrolysate-SR101 on Female College Students

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Abstract

This study was conducted to evaluate the weight reduction effect of yeast hydrolysate-SR101. Thirty female college students participated in a 6 week weight control program. All subjects were randomly assigned to either the placebo group, YH-SR101 (yeast hydrolysate-SR101) group, or eX diet (product of yeast hydrolysate-SR101) group. The mean energy intake of the placebo group was 1445.2±364.0 kcal (carbohydrate: 60.1%, protein: 25.6%, fat: 14.3%), while those of the YH-SR101 and the eX diet group were 1505.6±296.2 kcal (carbohydrate: 60.5%, protein: 22.2%, fat: 14.8%) and 1353.8±326.3 kcal (carbohydrate: 63.2%, protein: 20.9%, fat: 15.9%), respectively. The placebo group lost 0.19±1.14 kg of body weight, while the treatment groups (YH-SR101 and eX diet) lost 1.13±0.83 and 1.54±0.74 kg of body weight, respectively. There were significant differences in the decrease in body weight between the placebo and the treatment group ($p<0.05$). There were also significant differences in the decrease in fat mass between the placebo and treatment group ($p<0.05$). Furthermore, the BMI of the YH-SR101 and the eX diet groups also differed significantly before and after the diet program ($p<0.05$). Additionally, the BMI and waist size reduction of the treatment groups (YH-SR101 and eX diet group) differed significantly when compared to the placebo ($p<0.05$). The reduction of the resting metabolic rate (RMR) blood glucose, total-cholesterol, HDL-cholesterol, LDL-cholesterol and triglyceride did not differ significantly among groups. Taken together, these findings indicate that consumption of yeast hydrolysate-SR101 and eX Diet may lead to decreased body weight and fat.

Key words: yeast hydrolysate, weight loss, psyllium husk, female college students

INTRODUCTION

Obesity, which is characterized by an excess accumulation of fat in the body, is a chronic disease that is induced by many causes and requires long-term management (1). Obesity occurs worldwide and can lead to an increase in several other diseases, all of which can be fatal. Furthermore, obesity causes extreme economic losses related to the management of its related diseases (2-4).

Several methods have been employed in attempts to prevent and treat obesity and its related disorders. However, long-term management of body weight loss is often unsuccessful. Indeed, most studies of weight management have revealed an undesired weight regain (5-9), indicating that subjects did not change their eating and activity behavior adequately (10). Accordingly, interventions to improve long-term maintenance of eating activity are needed to effectively treat obesity. Additionally, the limited long-term effectiveness of conventional weight management (dietary intervention, physical activity, and behavioral therapy) has led to the development of alternative weight reduction strategies such as the use of natural supplements.

To provide new natural supplements, many studies have been conducted to evaluate the use of yeast for the treatment of obesity. The relationship between mankind and yeast dates back many thousands of years. Indeed, yeast is one of the most commercially exploited microorganisms, being used in the brewing (11), wine making (12), and baking (13) industries. Although yeast has traditionally been used in the aforementioned industries, only a few yeasts have been developed for commercial use in the biochemical and medical industry due to difficulty in elucidation of the mechanisms responsible for their physiological properties, such as their anti-obesity activity (14). Therefore, this study was conducted to investigate changes in weight, fat mass, lean body mass, waist & hip circumference, skinfold thickness, basic metabolic rate (RMR), and plasma glucose & lipids in young obese women that were administered yeast hydrolysate to determine if it would be useful as a supplement for the treatment of obesity.

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MATERIAL AND METHODS

Subjects

This study was conducted in female college students aged 20 to 28 years who were obese and had no other documented health problems. The body mass index (BMI) of the individual subjects was 25 kg/m^2 or higher, which is used as cutoff point for obesity in the Asia-Pacific region (15). Thirty-six women were selected for participation in this study (12 subjects/group). Four subjects failed to complete the study and 2 subjects were excluded because they were outliers with respect to their weight loss. Thus, the final subjects consisted of 30 women who were randomly allocated into placebo group (n=9), YH (yeast hydrolysate) group (n=12) and eX diet (product of yeast hydrolysate) group (n=9).

Study protocol

A randomized placebo controlled study was conducted for six weeks between November and December 2006 in Seoul, Korea. Subjects were randomly assigned into a placebo group, YH (yeast hydrolysate) group and an eX diet (product of yeast hydrolysate) group. The placebo group and YH group were asked to consume one pouch containing 1 g/pouch of treatment two times a day, while the eX diet group was asked to contain a 7 g pouch containing 1 g of yeast hydrolysate/pouch two times a day. The dosages used in this study were selected on the basis of our preliminary studies (16). The placebo group received only the vehicle, which was the same volume and color of the YH treatment and administered via the same route. To help ensure compliance, participants were asked to record the number of pouches taken at the end of each week and to return any unused pouches at the end of the study. All subjects were instructed to continue their regular diet and exercise patterns as usual. They also received instructions on how to record food intake and physical activity. The participants kept the records of the foods they had eaten and were required to engage in physical activity three times a week during the experimental period. The records of food intake and physical activity were analyzed by Can-Pro (Korean Nutrition Society, Korea) and http://obesity.dongduk.ac.kr/, respectively. All subjects also completed a side effect questionnaire once a week. This study was approved by the Ethical Committee for Human Experimentation of Korea University and was conducted in accordance with its rules and regulations.

Body characteristics

The height of the subjects was measured using the DS-102 (Jenix, Korea) prior to commencing the study. The weight, body fat and lean body mass were measured at the beginning of the study and at the 6th week using In Body 3.0 (Biospace, Korea) while the subjects were wearing light clothing and had an empty stomach. The waist and hip circumference were measured by using a tape measure, while the skinfold thickness of the triceps, subscapular, and abdomen were measured using the Skyndex System (Caldwell, USA). The measurements of all body characteristics except height were collected at the beginning of the experiment and at every subsequent visit.

RMR and plasma parameter

RMR was measured prior to commencing study and at the endpoint. RMR was measured in the morning while the subjects were in a fasted state and lying supine for 30 minutes using a MetaMax system Ⅱ (Cortex, Germany).

After fasting for 12 hr, blood samples were collected in 10 mL syringes fitted with 23 gauge, 1.9 cm disposable needles and heparin was used as an anticoagulant. The blood samples were immediately centrifuged at $2,000 \times g$ for 10 min at 4°C. Plasma was stored at -80°C until used for analysis of the glucose and lipid concentrations. Glucose, triglycerides, total cholesterol, and HDL-cholesterol were assayed using the EKTACHEM DT 60 Ⅱ System (Johnson & Johnson Clinical Diagnostics, USA). The LDL-cholesterol was estimated using the method validated by Friedewald et al. (14). Blood samples were drawn prior to commencing the study and on the 6th week of the study.

Yeast hydrolysate and eX diet

Saccharomyces cerevisiae IFO 2346 was incubated in medium containing 2% molasses, 0.6% $(NH_4)_2SO_4$, 0.1% $MgSO_4 \cdot 7H2O$, 0.2% KH_2PO_4, 0.03% K_2HPO_4, and 0.1% NaCl for 3 days at 30°C. After incubation, the culture was centrifuged at $10,000 \times g$ for 20 min. The cells were then suspended in 20 mM phosphate buffer (pH 7.0) and hydrolyzed with 1,000 units of bromelain at 30°C for 4 hr. The hydrolysate was subsequently centrifuged at $10,000 \times g$ for 20 min. Next, the supernatant was passed through a 10 kDa molecular weight cutoff membrane (Satocon cassette, Germany) and lyophilized. The yeast hydrolysate in the present study was composed of 4.7% moisture, 68.3% crude protein, 0.3% crude lipid, 3.1% crude ash and 23.6% carbohydrate.

The eX diet consisted of 50% psyllium husk powder, 30% lactobacillus ferment, 14.4% yeast hydrolysate, 2.8% hydroxycitrate (HCA), 2.0% L-carnitine, 0.5% ginseng flavor and 0.3% glucosyl stevia.

Statistical analysis

All statistical analyses were conducted using the

Statistical Package for Social Sciences (SPSS) for Windows (version 12.0). A paired *t*-test was used to assess the differences in each group at baseline and 6-weeks. The differences among groups were evaluated statistically by one-way analysis of variance (ANOVA) and Duncan's multiple tests. All data were analyzed using two-sided tests at the 5% significance level and were reported as the mean±standard deviation (SD).

RESULTS

Baseline and food intake

Table 1 shows the baseline characteristics of the subjects. At baseline, there were no significant differences among groups in terms of age, height, weight, BMI, fat ratio, fat mass, and lean body mass.

The mean energy intake and percentage of calories ingested as carbohydrates, fat, and protein are shown in Table 2. No significant differences in any of these variables were observed among groups at baseline. During treatment, the mean caloric intake increased from baseline across all groups, but there were no significant differences among groups. The supplement with yeast hydrolysate had no significant effect on the mean total caloric intake or percentage of calories ingested as carbohydrates, fat, and protein.

The physical activity of subjects did not differ significantly among all subjects before and during treatment or among groups (data was not shown).

Body composition

Table 3 shows the changes in body weight, fat ratio, fat mass, lean body mass, BMI, and BMR from baseline to endpoint. All groups lost body weight and BMI during treatment, but the baseline BMI of the placebo group did not differ significantly from the BMI at 6-weeks. In the yeast groups (YH group and eX diet group), body weight and BMI were significantly lower after 6 weeks of treatment ($p<0.05$). In the placebo group, the fat ratio (1.29%) and fat mass (0.77 kg) increased after 6 weeks of treatment. However, in the yeast groups, the fat ratio decreased during treatment (YH: -0.46%, eX diet: -1.56%), as did the fat mass (YH: -0.54 kg, eX diet: -0.52 kg). Additionally, the fat mass of the placebo group and the yeast groups differed significantly ($p<0.05$). Furthermore, the fat ratio was significantly lower in the eX diet group than in the YH group ($p<0.05$). Moreover, the lean body mass of all groups decreased significantly ($p<0.05$) after 6 weeks of treatment, and no significant differences were observed among groups. Finally, the BMR did not change significantly in any groups.

Table 1. Baseline characteristics of the subjects (mean±SD)

Body characteristics	Placebo group (n=9)	YH group (n=12)	eX diet group (n=9)
Age (yr)	21.5±1.0	21.5±0.8	21.5±0.8
Height (cm)	161.7±3.3	162.3±5.9	161.8±5.0
Weight (kg)	67.2±7.7	67.4±8.4	69.1±6.7
BMI[1] (kg/m^2)	25.7±2.7	25.6±2.3	26.4±2.4
Fat ratio (%)	25.8±4.4	26.4±3.8	29.4±4.7
Fat mass (kg)	17.3±4.0	17.8±4.2	20.3±4.5
Lean body mass (kg)	49.9±4.0	49.6±5.2	48.8±2.3

[1]BMI: Body mass index=body weight (kg)/ [height (m)]^2.

Body circumference, skinfold thickness, and plasma glucose and lipids

The changes in body circumference and skinfold thickness are shown in Table 4, while the changes in plasma glucose and lipids are shown in Table 5. None of these values differed significantly among groups. Additionally, these values did not differ significantly from baseline to the endpoint in any group, with the exception of waist circumference in the yeast group. Specifically, waist circumference decreased significantly from baseline to 6 weeks (YH: -2.03 cm, eX diet: -2.44 cm) in the YH group ($p<0.05$).

DISCUSSION

More than 50 individual dietary supplements and 125 proprietary products are listed in the Natural Medicines Comprehensive Database as commonly used for weight loss (17). Currently, no weight-loss supplements meet the criteria for recommended use (18). Although ephedra-caffeine combinations may be effective for modest weight loss, safety issues motivated the FDA to ban their sale in April of 2004. Chromium, which is a popular weight-loss supplement, is thought to play a role in carbohydrate and lipid metabolism, potentially influencing weight and body composition (19). However, data regarding healthy individuals without diabetes do not support this theory, and data pertaining to patients with diabetes are inconclusive (20). Guar gum (21), derived from the Indian cluster bean, *Cyamopsis tetragonolobus*, and chitosan (22), derived from chitin found in crustacean shells, appear to be ineffective; therefore, the use of products containing these compounds should be discouraged. Due to insufficient or conflicting evidence regarding the efficacy of conjugated linoleic acid (23), ginseng (24), glucomannan (25), green tea (26), hydroxycitric acid (27), L-carnitine (18), and pyruvate (28) for weight loss, physicians should caution patients about the use of such supplements and closely monitor those who choose to use these products.

Table 2. Energy, carbohydrate, protein, and fat intakes of the subjects during treatment (mean±SD)

Food intake	Placebo group (n=9)			YH group (n=12)			eX diet group (n=9)		
	Baseline	1～6 weeks	Δchange	Baseline	1～6 weeks	Δchange	Baseline	1～6 weeks	Δchange
Total calories (kcal)	1368.9±155.9	1445.2±364.0	76.2±275.4	1505.6±296.2	1508.8±369.2	3.2±355.9	1321.7±230.6	1353.8±326.3	32.1±255.7
Carbohydrate (%)	56.2±5.0	60.1±8.2	3.9±5.3	63.1±6.9	60.5±9.7	-2.5±5.6	63.0±6.4	63.2±9.9	0.2±5.2
Fat (%)	29.5±4.7	25.6±7.4	-3.8±4.8	22.2±5.8	24.6±8.8	2.4±4.0	21.7±8.4	20.9±8.9	-0.8±4.7
Protein (%)	14.4±3.0	14.3±3.0	-0.1±3.0	14.8±2.7	14.9±2.9	0.1±2.8	14.8±2.7	15.9±3.9	0.6±3.3

Table 3. Changes in body weight, fat ratio, fat mass, lean body mass, BMI[1)], and RMR[2)] (mean±SD)

Body characteristic	Placebo group (n=9)			YH group (n=12)			eX diet group (n=9)		
	Baseline	Week 6	Δchange	Baseline	Week 6	Δchange	Baseline	Week 6	Δchange
Body weight (kg)	67.2±7.7	67.0±7.6	-0.19±1.04^{b}	67.4±8.6	66.3±8.8	-1.13±0.83^{*a}	69.3±6.7	67.8±6.1	-1.54±0.73^{*a}
Fat ratio (%)	25.8±4.0	27.1±4.4	1.29±1.56^{*b}	26.4±4.4	25.9±3.9	-0.46±1.79^{b}	29.5±4.5	29.4±4.7	-1.56±1.66^{a}
Fat mass (kg)	17.3±4.0	18.1±4.6	0.77±1.14^{b}	17.8±4.2	17.3±4.0	-0.54±1.15^{a}	20.3±4.5	19.8±4.5	-0.52±1.04^{a}
Lean body mass (kg)	49.9±4.6	49.0±4.0	-0.96±1.03*	49.6±5.6	49.0±5.7	-0.59±0.61*	48.8±3.2	47.8±2.3	-1.02±1.11*
BMI (kg/m^2)	25.7±2.7	25.6±2.7	-0.08±0.42^{b}	25.6±2.4	25.2±2.4	-0.44±0.34^{*a}	26.4±2.4	25.8±2.2	-0.58±0.26^{*a}
BMR (kcal/d)	1816±265.6	1889±259.0	73±123	1674±339.1	1671±238.0	-23±211.9	1573±265.4	1581±239.5	8±209.8

[1)]BMI: Body mass index=body weight (kg)/ [height(m)]^2. [2)]BMR: Basic metabolic rate.
[*]Significant difference ($p<0.05$) between baseline and week 6. Lowercase letters: Significant difference ($p<0.05$) among groups.

Table 4. Changes in body circumference and skinfold thickness (mean±SD)

Body characteristic		Placebo group (n=9)			YH group (n=12)			eX diet group (n=9)		
		Baseline	Week 6	Δchange	Baseline	Week 6	Δchange	Baseline	Week 6	Δchange
Circumference	Waist (cm)	75.8±8.5	73.9±6.8	-1.93±2.93	74.0±7.3	72.0±6.4	-2.03±2.54*	77.8±8.0	75.4±7.1	-2.44±2.46*
	Hip (cm)	97.1±4.7	96.7±4.6	-1.39±1.50	98.1±6.4	96.9±6.3	-1.19±1.96	97.6±5.6	95.8±5.4	-1.67±2.96
	Waist/Hip ratio	0.77±0.06	0.76±0.75	-0.008±0.026	0.75±0.04	0.74±0.04	-0.013±0.029	0.80±0.06	0.79±0.06	-0.009±0.031
Skin fold thickness	Tricep (mm)	21.4±4.6	20.9±3.8	-0.5±3.4	23.2±3.6	22.5±4.5	-0.7±2.9	24.7±4.7	23.1±4.5	-1.6±2.1
	Subscapular (mm)	23.6±4.5	23.4±5.8	-0.2±3.2	21.2±3.5	21.0±4.2	-0.2±3.7	23.7±5.2	23.9±5.2	0.2±3.1
	Abdomen (mm)	24.1±4.1	23.7±4.3	-0.4±1.5	26.1±5.9	25.2±4.8	-0.9±3.3	28.7±4.3	28.2±5.2	-0.5±4.2

[*]Significant difference ($p<0.05$) between baseline and week 6.

Table 5. Changes in plasma glucose and lipids (mean±SD)

Serum (mg/dL)	Placebo group (n=9)			YH group (n=12)			eX diet group (n=9)		
	Baseline	Week 6	Δchange	Baseline	Week 6	Δchange	Baseline	Week 6	Δchange
Glucose	92.6±6.3	96.7±10.1	4.1±10.5	88.1±10.1	88.8±8.3	0.7±8.9	92.1±8.8	91.0±8.6	-1.1±10.9
Triglyceride	105.3±43.3	116.6±54.4	11.2±31.1	93.1±45.0	89.3±39.8	-3.8±33.6	94.3±28.8	94.9±46.0	0.6±29.4
Total cholesterol	206.3±18.6	200.7±25.0	-5.7±25.4	176.6±26.8	177.8±31.3	0.7±17.6	193.3±31.7	182.3±29.6	-11±30.0
HDL[1)] cholesterol	60.7±9.5	63.1±7.7	2.4±8.4	58.0±12.3	59.6±15.7	1.6±8.1	57.6±10.8	55.5±12.5	-2.6±6.7
LDL[2)] cholesterol	124.6±21.0	114.2±19.3	-10.4±25.8	100.0±23.8	99.8±28.4	-0.2±21.6	116.9±26.8	108.4±24.4	-8.6±32.1

[1)]HDL: High density lipoprotein. [2)]LDL: Low density lipoprotein.

In our previous study (29), we demonstrated that yeast hydrolysate showed an anti-stress effect similar to that of St. John's wort, which is well known as a botanical remedy for depression. Additionally, yeast hydrolysate stimulated the activation of macrophages and interleukin-6 production in rats. In addition, the swimming time of mice administrated yeast hydrolysate was gradually increased and significantly enhanced when compared to the placebo group. It has also been suggested that the anti-fatigue effect of yeast hydrolysate is related to reduced stress, the induction of intensive exercise and enhanced immunity. Hong et al. (30) reported that the velocity of epididymal sperm in mice administrated yeast hydrolysate improved. In a human study, yeast hydrolysate reduced the intensity of somatic symptoms, emotional symptoms, and behavioral symptoms on premenstrual syndrome (31). Taken together, these studies demonstrate that yeast hydrolysate has various physiological functions.

Recently, we assessed the anti-obesity effect of yeast hydrolysate and found that it reduced body weight in rats fed a high fat diet. Furthermore, the intake of yeast hydrolysates was found to reduce the levels of plasma triacylglyceride (TG) and the weight of epididymal and perirenal fat pads (32). A number of neurotransmitters and peptide hormones reduce food intake acutely but have minimal long term effects on body weight (33). For example, nitric oxide synthase (NOS) inhibitors reduced food intake in rodents (34). Nitric oxide (NO) is a biological messenger molecule that is synthesized in high levels in the brain and other mammalian tissues (35). Additionally, it has been reported that NO, which is a ubiquitous neurotransmitter, has functions related to vasoactive intestinal peptide (VIP) and regulates the release of VIP in the peripheral and central nervous system. Therefore, to investigate the effects of yeast hydrolysate on appetite regulation mechanisms in the central nervous system, the level of NOS expression and VIP immunoreactivity in the paraventricular nucleus (PVN) and ventromedial hypothalamic nucleus (VMH) of the hypothalamus were evaluated using histochemical methods (36). The results revealed that the administration of yeast hydrolysate below 10 kDa reduced body weight gain, TG and total cholesterol (TC) levels in SD rats when compared to the control, although 10～30 kDa yeast hydrolysate did not show any anti-obesity effects.

Although yeast hydrolysate is a novel natural supplement with the possibility to induce weight loss, there are few reports regarding the efficacy and safety of yeast hydrolysate. In the present study, we examined the effects of yeast hydrolysate on the body weight and fat content of young obese women to determine if it had the potential for use in functional foods and medicines designed to induce weight loss. The results of this study indicate that the intake of yeast hydrolysate led to a significant reduction in body weight and BMI when compared with a placebo group ($p<0.05$) (Table 3). Additionally, the decrease in absolute fat mass was significantly higher ($p<0.05$) in the yeast groups (YH: -0.54 kg, eX diet: -0.52 kg) than in the placebo group (0.77 kg). The eX diet group also showed a greater decrease in fat mass than the YH group. The ex diet contained common dietary supplements used for weight loss such as psyllium and HCA. Numerous weight-loss products contain sources of soluble fiber, which are meant to absorb water within the gut, causing increased satiety and lower caloric intake. Fiber, guar gum (derived from the Indian cluster bean, *Cyamopsis tetragonolobus*), glucomannan (*Amorphophallus konjac*), and psyllium (derived from the seed husk of *Plantago psyllium*), may also improve control of diabetes and hyperlipidemia, two common comorbidities in patients with obesity (37). Hydroxycitric acid (HCA) is derived from the Malabar tamarind tropical fruit (*Garcinia cambogia*), which is native to India. HCA has been found to inhibit mitochondrial citratelyase, leading to decreased acetyl coenzyme A production and decreased fatty acid synthesis (38).

Taken together, the results of this study suggest that yeast hydrolysate may have beneficial properties that would make it useful as a weight loss supplement. Therefore, yeast hydrolysate may be recommended as an anti-obesity functional food. Further studies will be conducted to elucidate the principle components and mechanism responsible for anti-obesity.

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